NARAC Software Quality Assurance Process Overview

Background. Emergency response modeling systems must be extensively validated in order to verify and validate that they have been implemented properly, produce realistic predictions, and are reliable in emergency conditions. The NARAC models and software systems are rigorously tested and evaluated in multiple ways with each new version of the major models and system components.

NARAC Central System Models. Verification of the core NARAC models proceeds on three fronts:
1. comparison with analytic results
2. statistical comparison with a large and growing number of field experiments
3. analysis of operational model applications, particularly when the response or exercise has a field measurement component that supports evaluation of model performance.

The model development team is currently upgrading their testing procedures to automate the execution of the standard tests and the comparison of test results against benchmark results. The documentation of the model development, verification, validation and acceptance procedures is contained in several scientific papers, and is continuously being updated as additional studies are completed and documented. A list of publications will be available on the NARAC Web site (http://narac.llnl.gov) and the LLNL library Web site (http://www.llnl.gov/library/).

Software Development. Verification of the software systems requires several levels of testing; including developer, unit, integration, system and acceptance tests. To effectively manage these validation steps, multiple systems (domains) are maintained, each of which focuses on a different aspect of the validation process. Software development is performed in private domains and integrated at an early stage into the development domain. The development domain is a complete running version of the system and allows new or updated capabilities to be tested in the full system. Once a complete package of the system is tagged for production release, an appropriate range of unit, integration and system tests are completed. The package is then installed in the beta domain and is exercised by system and acceptance tests. The acceptance tests are user-driven and focus on new or changed functionality. Automated system tests verify that previous functionality is still correct and that performance has not been degraded. Once the new package is accepted by Operations, it is installed into the production domains using procedures that ensure that the operational system is available at all times. The migration of new releases towards the production environment is coordinated with the software version control system.

The procedures for testing the system software are mature. The documentation of these procedures is currently being updated with the latest information. This updating of the NARAC SQA documentation is being aligned with the recently adopted LLNL risk-based policies on Software Quality Assurance. The documentation updates of core aspects of both the model and systems software will be completed over the next several months. Note that the testing procedures are continually being improved to meet the expanding scope of the NARAC mission and the associated growth in capabilities.

New software development is always designed in the context of the existing operational system and the level of formalism is tuned to the risk associated with the new feature. For example, correcting a simple spelling error in a user interface will require no formalism other than that implied by the change tracking and update procedures, while a major new subsystem will incorporate design reviews with documentation as needed to understand the task, the new design and its impacts on the existing system.

Operational Testing and Feedback. A key aspect of both model and system quality assurance in NARAC is the continuous evaluation of all aspects of the performance of the system. Every automated model request initiated via the iClient or NARAC Web (500-1000 per month) is tracked and all failures are analyzed to identify problems with the models, system software or system

configuration. Also, every response and significant exercise is followed by a hot-wash where all aspects of the system are evaluated. Any component failures or weaknesses identified are submitted to the NARAC requirements and software change tracking system to ensure that all necessary improvements move into the operational environment.

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